WORKSHOP THEME

"ENHANCING READINESS THROUGH ENVIRONMENTAL QUALITY TECHNOLOGY"

THE U.S. ARMY PERSPECTIVE

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- ***Readiness***

Readiness! The Army's ability to maintain a well-equipped, well-trained military is our number one priority. Environmental technology enhances readiness by preserving access to the air, land, and water necessary for training and testing. In addition, by maintaining a safe, healthful, and environmentally sound place to work, the Army maintains a high quality of life for the men and women who work and live on our military installations. Those men and women protect the national security. We, through our efforts, protect them.

This is accomplished in many ways. Through environmental restoration more land is available for training and living, through pollution prevention the costs of managing our hazardous wastes are reduced so that more funds are available for training, through compliance facilities continue to be available to test and maintain our forces, and through conservation the lands used for training retain their realistic nature and provide better environments for solders and their families.

But, accomplishing these things is also costly, time consuming and sometimes labor intensive. So, that is why there is a great need for new environmental technologies. Technologies that can make these accomplishments better, faster, cheaper, or safer.

• *What's happening*

Let's look at the areas where technology is needed and some of the technologies that are being introduced.

⇒ *Restoration*

Restoration is the largest area where technology can make a big dollar impact. Millions of acres of soil and millions of gallons of groundwater are contaminated through past practices. Contaminants include petroleum products, solvents, metals, explosives, chemical agents, and depleted uranium. In accordance with "Project Reliance" the Army focuses on explosives, site characterization, metals, and unexploded ordnance.

* Explosives

It was the U. S. Army Environmental Center that pioneered the use of incineration for explosive contaminated soil. It has been used to clean up soil contamination at Louisiana Army Ammunition Plant, Cornhusker Army Ammunition Plant, Savanna Depot Activity, and Alabama Army Ammunition Plant.

In recent years new technologies have been developed to deal with explosives. These have moved into the realm of biological degradation. The first to be demonstrated was composting. At Umatilla Army Depot Activity soils from a wash out pond were composted with local manures in static piles and by windrow. TNT was shown to be degraded and the resultant mixture was non-toxic. Based on this demonstration windrow composting was chosen to be the remedial action in the record of decision. The next was aerobic bioslurry both by itself and biosurfactant enhanced. The result was that this process can degrade explosive contamination and be an alternative to incineration. This process is being considered in the feasibility study of the Joliet Army Ammunition Plant.

While aerobic bioslurries have proven successful for the degradation of explosive contaminated soils anaerobic microbes work by a different metabolic process. This differing process is expected to aid in the degradation of more recalcitrant compounds such as RDX.

The use of plants to degrade explosives is presently getting greater attention. At present the most favorable technologies to remediate explosive contaminated soil are all ex-situ. No truly in-situ process has yet been found. But, phytoremediation could be that process. Many plants have been found that have a nitroreductase enzyme. These plants can degrade explosive contaminants. This is not just a process of plant uptake but one of actual degradation. The Army Environmental Center is presently working on a demonstration of phytoremediation in a wetland environment for explosive contaminated groundwater. But, this could be transferred directly to soils if proven successful.

* **Heavy Metals**

Heavy Metal soil contamination has also been a long standing problem. The two most used remedial actions at present are stabilization and dig and haul. While both technologies take the immediate problem away, they do not necessarily offer a permanent solution or an end to liability. So, now the use of soilwashing and leaching is being demonstrated. At the Twin Cities Army Ammunition Plant this process was used to remediate a lead contaminated site. The site was cleaned up and the lead was removed and recycled thus ending the chain of liability. While this process is effective for many metals it still has some disadvantages. The process is ex-situ, requires a large amount of equipment, and can be troubled by some metals such as mercury.

Up coming technologies for heavy metal soil contamination include phytoremediation and electrokinetics. Plants have also been shown to uptake metals. Therefore certain plant species can be grown in contaminated soil and after the growing season be cultivated, ashed, and the ash smelted. Electrokinetics is a process of placing an anode and a cathode in the soil, applying an electric current across the electrodes resulting in a current flow. Basically, by sending a current through the soil metal ions will migrate according to charge to the appropriate electrode and either be plated out onto the electrode or can be removed with the electrolyte solution produced. This has been pilot tested at Fort Polk where with the electrodes spaced six feet apart. 95% of the lead in the soil was removed. If demonstrated successfully at a large scale this process has the ability to be the in-situ answer to heavy metal contamination in many cases.

* **Other Contamination**

One other area of concern for the Army is Unexploded Ordnance. While not a soil contaminant in itself we do consider it a soil remediation problem especially at installations selected for closure. The Army has a very active program for unexploded ordnance detection and remediation. The Army Environmental Center

has set up a seeded test bed at Jefferson Proving Ground to allow primarily private sector companies to come in and demonstrate their capabilities in over-the-land and airborne unexploded ordnance detection.

In addition, the Center is also working on the development of better unexploded ordnance detection and remediation technologies such as the Subsurface Ordnance Characterization System (SOCS). SOCS is a test-bed system that simultaneously acquires data from a variety of mounted UXO detection sensors. The system's flexible, open architecture enables it to readily use different sensor technologies for UXO detection, identification, and localization.

The SOCS was successfully demonstrated at Tyndall AFB. The demo included a survey of a 1.5-acre test site that contained metal storage drums and buried inert ordnance. The results of the demo showed that the SOCS subsystems (e.g., navigation, autonomous vehicle control, sensors and data acquisition) could be successfully integrated and operated to characterize a site containing UXO.

* **Site Characterization**

Characterization of sites has been a long and costly activity. Technology has allowed us to achieve finer detail at contaminated sites, but at a cost. That cost often is more expensive equipment and longer analytical times.

Chromatography expanded our ability to look for suites of compounds. It also required skilled operators and large amounts of sample preparation. So, we began to look for analytical tools that could be used closer to the site of contamination. This led to some field kits. Field kits, as their name implies, were analytical tools that could be used in the field. The draw back was that most of these kits were only capable of gross measurements. Better tools were developed such as X-Ray Florescence. This technology has been of great benefit to quick field measurements. But, the application of this technology is limited.

The next generation of field portable analytical instrument is the SCAPS or Site Characterization and Analysis Penetrometer System. This system is a truck containing a hydraulic press that can push a probe into the soil. Based upon the sensor within the probe the SCAPS can measure what contaminants are present either in the soil or groundwater. Presently the most accepted sensor used by the SCAPS is one for petroleum products. Being demonstrated now

are additional sensors for volatile organic compounds, metals, and explosives.

Finally, the future could be the Ion-Trap Mass Spectrometer (ITMS). The ITMS is an analytical tool the is field portable, relatively easy to use, requires little sample preparation, and can provide near real time to real time monitoring of contaminants. Presently the ITMS is validated for the analysis of volatile organic compounds. Additional validation on other contaminants is continuing.

⇒ *Pollution Prevention*

There are many areas where the services can prevent or reduce pollution and many organizations are working on various problems unique to its service and of value to all services. Most pollution prevention activities focus on the industrial aspects but many military facilities have pollution prevention needs that are not industrially oriented. Some specific areas include wash racks and antifreeze recycling.

Washracks are used on everything from cars to tanks but often the existing racks are not designed to handle the kind of load the Army asks of them. The Army Environmental Center is demonstrating different washracks to determine the capabilities of differing systems so that recommendations can be made to installations on which type to purchase and use depending on the intended purpose.

A primary fluid used by the services is antifreeze. Millions of gallons of antifreeze are changed each year with the used antifreeze being disposed of. Technology has been developed to recycle antifreeze and to do it in such a way as to have the recycled product meet military specifications. The problem is that many facilities do not know this or use the recyclers incorrectly. The Center is taking GSA available recyclers and installing them in a few locations and developing installation, maintenance, and operational SOPs so that the facilities can use these recyclers properly and save money.

Pollution prevention can apply directly to range managers such as through lead build up on small arms ranges. With millions or rounds of small arms ammunition used each year in training exercises lead and lead run off can be a big problem. Methods to stabilize small arms range berms are presently being demonstrated to reduce erosion and run off and to better contain the lead bullets to prevent migration.

Closely related to lead on ranges is looking up the pipe, back to the ammunition itself. A project called "Green Ammunition" is

presently ongoing to make small arms ammunition more environmentally friendly. This project is looking at the lead bullet and the material in the primer. Substitutes are available for lead such as tungsten that can provide equal ballistics but not have the toxicity of lead. Also, new formulations are being developed for the primer that remove the hazardous material such as lead and actually provide greater power.

⇒ *Compliance*

Compliance with environmental laws such as the Clean Air Act and the Resource Conservation and Recovery Act can affect readiness. Military equipment must be protected from the elements and chemicals that they may come in contact with either during training or warfighting. The Army uses a compound called CARC or Chemical Agent Resistant Coating to protect its equipment. The present formulation of CARC is very much like paint and uses an organic base. This causes installations to spend a lot of time and funds on compliance with the Clean Air Act and volatile organic compound emission limitations and RCRA for the generation of hazardous waste that is associated with the protecting of the equipment. The Army is presently demonstrating a new formulation of CARC that is low volatile organic compound that will reduce many of the regulatory burdens.

Managing and monitoring hazardous materials and hazardous wastes is required by environmental regulations. Monitoring these items can also lead to better methods to store, distribute, and track generators of hazardous wastes. The Army is fielding a system called the Hazardous Substance Management System (HSMS) to track and report hazardous materials and wastes. This system was developed by the Navy and is being transitioned to the other services.

Biofiltration is another innovation coming to assist compliance. Presently, facilities that emit volatile organic or petroleum vapors must contain or destroy them. Technologies such as dry filters, water curtains, incinerators, and granular activated carbon are now used to do this work. A biofilter uses natural microbes to degrade the compounds thus disposing of the waste without the installation required to do further work. Biofilters have been proven for petroleum products and are now being demonstrated for volatile organic compounds.

One method a material can become a hazardous waste is by improper handling practices. When troops are in the field and training it is difficult to provide adequate and proper hazardous material storage and disbursement facilities. The Center is working to provide designs for this type of facility that can be

taken into the field and reduce the amount of hazardous waste generated.

⇒ *Conservation*

What environmental area could better focus on readiness than conservation. Conservation, by definition, is the controlled use and systematic protection of natural resources, as forests and waterways.

Dust Control during training operations is a major problem on military installations. Wheeled and tracked vehicles stir up huge amounts of fugitive dust as they move across dry, unsurfaced landscapes. Dust clouds limit soldiers' visibility, cause excessive wear and tear on equipment, create an air quality hazard, and can signal troop positions to enemy forces during training scenarios. A demonstration of a number of commercially available dust control agents is being conducted in large-scale field areas to determine the ability to reduce fugitive dust and compare cost and ease of use.

To maintain training lands in as realistic a setting as possible those lands must be rehabilitated after training is complete. To aid in this a program called VegSpec has been developed. In a collaborative effort between the Army and the Natural Resource Conservation Service, VegSpec provides land managers a method to select and combine plant species to revegitate damaged areas faster and with greater success. The program not only identifies the best species for the area but also aids the land manager by recommending seeding rates, dates for best growth, planting method, site preparation, cover requirements, and soil amendments.

The opposite problem also exists on military lands. The problem of how to deal with plant species that are noxious or nuisance. Presently pesticides are most often used to control these species. Pesticide use is in itself a problem and one the military is trying to reduce. So, a system to manage noxious and nuisance plants has been developed. This system contains information on a number of noxious and nuisance plant species and provides alternatives to pesticide usage such as biological controls that can be used. The system can also help with pesticide usage by identifying alternative pesticides or application practices.

Small arms range berm redesigns were discussed under pollution prevention but another method to reduce lead on ranges is the use of bullet traps. Bullet traps do as the name implies they trap bullets and contain them so that they do not get into the environment. A search has been made of existing bullet trap

designs and their application. The next step is to demonstrate the better designs at actual firing ranges.

- ***Cooperation and Coordination***

To better make environmental technologies applicable to readiness and other needs many partnerships are needed. The Army is cooperating with the Air Force, Navy, and other Federal agencies to leverage knowledge and ability. The Army is also making use of the Strategic Environmental Research and Development Program and the Environmental Security Technology Certification Program to leverage funds to ensure that good technologies get developed and demonstrated.

⇒ *Tri-Service Environmental Centers Coordination Committee*

All of the military services have similar problems and each has a center to focus on these problems. To better aid in the transfer of information among the services the service center commanders got together and formed the Tri-Service Environmental Centers Coordination Committee. The purpose of the Committee is for the U. S. Army Environmental Center, U. S. Air Force Center of Environmental Excellence, and the U.S. Navy Facilities Engineering Service Center to exchange programmatic, regulatory, and technical information and develop and coordinate joint service activities relative to the programs, activities, matters, and issues of concern to the tri-service environmental centers that enhance the readiness posture of the services.

A charter has been executed by the Center Commanders and provide that each will exchange information and partner on research, development, demonstration, and transfer of environmental technologies and work together to gain acceptance of technologies by regulatory agencies among many other areas of interest to all of the services.

The committee meets at least three time a year and is already accomplishing many tri-service actions. Actions such as this tri-service environmental technology workshop, the development and acceptance of a tri-service "ecological risk assessment protocol" that will allow each service to conduct ecological risk assessments and present these as standard to the regulatory bodies, a tri-service pollution prevention handbook, regional office coordination, and partnered technology project proposals.

- ***Challenges***

⇒ *Timely Availability*

Environmental technologies that are better, cheaper, faster, safer, or more acceptable are needed now not ten years from now. Good ideas that languish in the laboratory will be the death of themselves. With environmental funding going down and more and more sites entering the actual clean up phase if technologies are not available in the next two to maybe three years they will not be used or useful.

⇒ *Reliable Funding*

Second, because there are available technologies that need to get into the field from either Federal labs or the private sector there needs to be a reliable source of demonstration funding. The Army has not made available any research and development (6.4) money for the demonstration of environmental technologies. Some talk about SERDP (the Strategic Environmental Research and Development Program) and ESTCP (Environmental Security Technology Certification Program) as being the funding sources. But, this is not the case. SERDP is for basic and applied research not demonstration and is down to about 25% of what it once was. ESTCP while actually for the demonstration of environmental technologies may not exist next year with all of the budget cutbacks. Also, with the number of congressional earmarks the amount of funding available for demonstrations that the services actually need is small. Compounded by the fact that a small amount of funding has to be spread among the services and the length of time it takes to get the money to the actual executors this program does not begin to cover the need.

• *Summary*

Readiness and environmental protection are not competitors they are complimentary. As the Army strives to maintain the readiness of our warfighters they can also conserve the environment and benefit from environmental regulation. But, new tools and methods will be needed in order to continue to provide realistic training. The Army is working on these issues and in many areas we are succeeding. The direct benefits to the Army and all of the military will be better training facilities and realism, more training opportunities, and reduced life cycle operating and maintenance costs.